# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s):

Robert Cochran and Jeffrey D. Ferreira-Pro

Assignee:

Hewlett-Packard Development Company L.P.

Title:

HIERARCHICAL STORAGE SYSTEM

Serial No.:

10/697,821

Filing Date:

October 29, 2003

Examiner:

Vy, Hung T

Group Art Unit:

9535

Docket No.:

200311026-1

Confirmation No.:

9535

Irvine, California September 18, 2006

COMMISSIONER FOR PATENTS P.O. Box 1450 Alexandria, VA 22313-1450

# **DECLARATION UNDER 37 CFR 1.131**

We are applicants of the above-identified patent application and co-inventors of the subject matter described and claimed therein.

We were employed by Hewlett Packard Company, assignee of the above-identified patent application, at conception of the subject matter.

We believe we are original, first and joint inventors of subject matter (process, machine, manufacture, or composition of matter, or an improvement thereof) which is claimed and for which a patent is sought by way of the above-identified application.

Reference Matsunami et al. (U.S. Publication No. 2004/0193760), has been cited by the Examiner in rejecting Applicants' Claims 1-25 under 35 U.S.C. §102(e). The international filing date of Matsunami et al. is March 27, 2003. As described herein, the subject matter set forth in Claims 1-25 of the application was conceived in the United States

prior to March 27, 2003, and the applicants proceeded with due diligence from prior to the reference date to the filing of the application.

Prior to March 27, 2003, we conceived of the subject matter that is claimed in the above-identified patent application. Also prior to March 27, 2003 we filed an invention disclosure with Hewlett-Packard Company, assignee of the above-identified application. The application was prepared and filed in due course on October 29, 2003.

Attached hereto as exhibit I are five pages that comprise a copy of an official Invention Disclosure form that is used according to official Hewlett Packard procedures. Versions of Invention Disclosure were prepared and submitted on March 8, 2003 and March 11, 2003. The first two pages of the Invention Disclosure include reference material, title, inventors, and inventor contact information. Third and fifth pages describe technical aspects of an embodiment showing the claimed structure and techniques including the storage system comprising a storage array containing a plurality of storage devices of at least three types (including Fibre Channel (FC) and Serial ATA (S-ATA) and having a respective class hierarchy. The disclosure also shows a controller coupled to the storage device hierarchy and capable of executing an hierarchical storage management capability that selectively controls access to the hierarchy of storage devices corresponding to claims 1, 10, 18, and 25. Also shown are specifics of the priority of the hierarchy, as claimed in independent claims.

We declare that all acts in conception of the invention occurred in the United States.

We declare that all statements made herein of my own knowledge are true, all statements made herein on information and belief are believed to be true, and all statements made herein are made with the knowledge that whoever, in any matter within the jurisdiction of the Patent and Trademark Office, knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact, or makes any false, fictitious or fraudulent statements or representations, or makes or uses any false writing or document knowing the same to contain any false, fictitious or fraudulent statement or entry, shall be subject to the penalties including fine or imprisonment or both as set forth under 18 U.S.C. 1001, and that violations of this paragraph may jeopardize the validity of the application or this document, or

08/15/2006 17:34 FAX 9492510260

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herefrom.			
Full name of joint inventor: nventor's Signature:	Hober Coehran	Date: 🔎	15-06
Residence; Post Office Address:	Horeville, CA 3050 Markham Way Horeville, CA 95747	Citiz <b>enship</b> :	U.S.A.
Full name of joint inventor: nventor's Signature:	Josh by D. Ferricira-Pro	Date;	
Residence; Post Office Address:	Folsom, CA Physic gueroa St. Celeren, CA 95630	Citizenship:	U.S.A.
	-Page 3 of 3 —		

the validity or enforceability	y of any patent, trademark re	gistration, or cerui	icate resuming
therefrom.			
Full name of joint inventor: inventor's Signature:	Robert Cochran	Date:	
Residence: Post Office Address:	Roseville, CA 3256 Markham Way Roseville, CA 95747	Citizenship:	U.S.A.
Full name of joint inventor: Inventor's Signature:	Jeffrey J. Ferrician Prof	Servate:	9-15-06
Residence: Post Office Address:	868 Figueroa St. Folsom, CA 95630	Citizenship;	U-S-A-

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I am patent attorney who prepared and filed the above-identified patent application.

"Reasonable diligence is all that is required of the attorney. Reasonable diligence is established if attorney worked reasonably hard on the application during the continuous critical period. If the attorney has a reasonable backlog of unrelated cases which he takes up in chronological order and carries out expeditiously, that is sufficient". Manual of Patent Examining Procedure (MPEP) §2138.06.

Hewlett-Packard Company has an extensive patent program, having tens of thousands of patents globally. Patent procedures include review and analysis of a large number of patent disclosures, leading to assignment of selected disclosures for patent preparation. Hewlett-Packard Company exercised reasonable diligence in review and analysis of the disclosures from submission of the disclosure on about March 11, 2003, to distribution of the disclosure assignment of June 30, 2003. The review and handling time from March 11, 2003,

to June 30, 2003, is believed to be reasonable and normal for a technology company of the size and technical complexity of Hewlett-Packard Company.

On June 30, 2003, I received a disclosure document and request for quote from Hewlett-Packard Company, assignee of the above-identified patent application. I diligently prepared the application and filed on October 30, 2003, including interaction with inventors, preparation of the patent draft, preparation of drawings, and review by in-house corporate counsel. The disclosure document was received by Hewlett-Packard Company on March 17, 2003 showing diligence from a time just prior to the reference date of March 27, 2003, to filing.

I have attached copies documents that establish invention conception prior to the reference date and diligence from a time prior to the reference date and filing. Evidentiary documents include:

Exhibit I is a copy of the disclosure document received by Hewlett-Packard Company on March 8, 2003, with supplemental addendum on March 8, 2003. Other dates that establish earlier conception are blocked off. The first two pages of the Invention Disclosure include reference material, title, inventors, and inventor contact information. Third and fifth pages describe technical aspects of an embodiment showing the claimed structure and techniques including the storage system comprising a storage array containing a plurality of storage devices of at least three types (including Fibre Channel (FC) and Serial ATA (S-ATA) and having a respective class hierarchy. The disclosure also shows a controller coupled to the storage device hierarchy and capable of executing an hierarchical storage management capability that selectively controls access to the hierarchy of storage devices corresponding to claims 1, 10, 18, and 25. Also shown are specifics of the priority of the hierarchy, as claimed in independent claims.

Exhibit II are nine pages of an official document for usage in Hewlett-Packard's Disclose 4.5 – HP Invention Disclosure System. The document includes invention disclosure material on the first two pages, inventor information and other administrative information on third and fourth pages, some of which is blacked out for privacy purposes, and the final five pages are disclosure material that duplicates appendix I. The disclosure material shows

submission on March 11, 2003, showing invention prior to the date of the reference cited by the Examiner. The fourth page shows that the disclosure was received by the Hewlett-Packard legal department on March 17, 2003.

Exhibit III is an email dated June 30, 2003. In combination, exhibits II and III show diligence in review of the disclosure and determining whether to proceed on the application in the time from submission of the disclosure on March 11, 2003, to emailing the disclosure to outside counsel on June 30, 2003. The filing date of October 29, 2003 indicates diligence in working with inventors to prepare the application, and review by corporate counsel.

I declare that all statements made herein of my own knowledge are true, all statements made herein on information and belief are believed to be true, and all statements made herein are made with the knowledge that whoever, in any matter within the jurisdiction of the Patent and Trademark Office, knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or device a material fact, or makes any false, fictitious or fraudulent statements or representations, or makes or uses any false writing or document knowing the same to contain any false, fictitious or fraudulent statement or entry, shall be subject to the penalties including fine or imprisonment or both as set forth under 18 U.S.C. 1001, and that violations of this paragraph may jeopardize the validity of the application or this document, or the validity or enforceability of any patent, trademark registration, or certificate resulting therefrom.

Full name of attorney:	Ken J. Koestner		
Attorney's Signature:		_ Date:	
Residence:	Newport Beach, California		
Post Office Address:	18662 MacArthur Blvd, Ste. 400	Citizenship:	U.S.A.
	Irvine, CA 92612		

## Exhibit I

# AHRS - ERS

#### Rev. 1

# External Reference Specification for: AHRS -- Array-based Hierarchal Rotational Storage

[To Accompany the Palent Osaclosure by the same name. Intended to supply sufficient data that someone explicit in the crit could use the ERS to implement a working model.]

Thumbhail Skelch: Traditional cisk arrays have any 2 haves in marached storage (4) volume soft state states that of the state states are described as the states are descr

This patent describes a disk analy <u>condicus, decade historisk.</u> There is a historistically offered level of low-cood (= 1.0 ± 15°) this prize of PC distro), lower read-missing Sectal ATA (BATA) diskes which pure the cade for tempolary historisms (but if (box)) scored a situation HEM-type low unago user data strongs.

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- PLMVS Primary Lodal Million Visiting Stranger (docker # 100001050)
- . SLM . Scattcher Lecoliny Billigistics (not yet submitted).
- . BUNCE Rackup (Mindou (Condital) Protection (Ind. Selection)

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Jeff Ferreira-Pro\_HP ROBEMIN

#### **HP Confidential**

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Page 3

3/25/2003

# **High-Level Introduction**

Traditional disk arrays have only 2 levels of hierarchical storage.

(9) solid state cechershared-matricky, 31td (2) high-performance, high-priced (3-5 centa/MB) SCSVFC diates (rotational storage).

This patient describes a disk array rotational storage hierarchy. That is, a hierarchically interior level of low-price (~ 1/3 - 1/5 the price of FC disks), lower-performance Serial ATA (SATA) drives which can be used for temporary/anaxpected (but critical) storage and/or for HSM-type low usage user della aforage.

SATA drives excessed to the array are not new (nor are SATA-only arrays), what is new is the hierarchical inbulge of FC/SCSI and SATA drives within the same array, with the firmware empowered to offer some SATA storage for low access customer data (as in FW based HSM) and to retain some for critical affort term and unpredictable storage needs that are not appropriate for volatile cache/shared-memory or high price/performance non-volatile storage (or for which these is no pre-allocated apace).

This concept to ideal to be used with several prior patent submissions in which extra storage page (without the constraints of kUN copy licensos, pre-assignment or pre-configuration) is space (without the constraints of kUN copy licensos, pre-assignment or pre-configuration) is unexpectedly and temporarily/critically needed within a disk array (as opposed to having to consider the unconventional use of hat spare disks). Specifically, the patent entitled "Backup Window Overdraft Protection" (SWOP) in which a customer (that does not have licensed LUN. copy or enspehol functionicity, or does not cumbrilly theve it set up for Zero Downtime Eachup) is about to exceed their backup window, thus losing the entire backup. AHRS empowers BWOP to salvage the endangered backup using temporary non-votable storage of sufficient capacity.

The AHRS concept would be a algorithmal competitive differentialer and potential lock-out spac. Customers strated to this feature would be in the mid and high-end range. This feature could result in colution configurations involving algorithms production-vices drag to several parts of IHP.

NOTE: If this concept were an enabler for just a single related parent, I would have been tempted to combine the two. However, the fact that R equally enables at least 4 other patents, suggests that it should not become entangled identified with any one of them.

Page 4

3/25/2003

### What's Not New - (Prior Art)

- FC Disk arrays
- SATA Disk Drives
- Host SW controlled HSM (via external components)
- Intra-array LUN replication (e.g. snepshots and full copies)
- Inter-array LUN replication
- AutoRAID, disk array FW which moves data between RAID-1 and RAID-5 disk groups, depending on usage patterns (still all high-cost FC disks)
   Auto-LUN, host SW which moves files between RAID-1 and RAID-5 disk
- groups (and 10k rpm and 15k rpm), depending on usage patterns (still all high-cost FC disks)

HP-NSS R&D (Network Storage Solutions)

-Page 7 of 18 -

Page 5

3/25/2003

What "is" new - The Proposed improvements

Firmware-based Hierarchical Storage Management (HSM) within a disk army utilizing both FC and SATA disk drives would be new. In this context, array FW could save the SATA storage as uncommitted/unstructured and only use it for:

- Low Usage files (toterant of lower performance)
  Temporary (but critical), uncommitted, non-welsate storage that may or may not be presitiocated two specific LUNE:

  BRILIAR Sater Bitmap LUN Marror Resync(10011270)

  PILMYS Primary Local March Volume Standow (100201390)

  SUM Snepshot Liability Mitigation (not yet submitted)

  BMOP Gackup Window Overdros Pretection (not yet submitted)
- storagene MLI grapatiots
- Intra-erray full LUIN copies Inter-erray LUIN copies

This concept is ideal to be used with several prior patent submissions:

- SBLMR Safer Birmep LUN Mirror Resynciatocket #10011270
- PCMV5 Primary Lucal Mirror Volume Shedow [docket #100201390]
- SLM Snepshot Lability Mitigation (not yet submitted) BYOP Backup Window Overdrell Protection (not yet submitted)

in which extra storage space (willnow the constraints of LUN copy licenses, pre-assignment of pre-configuration) is undepectedly and temporarily/critically niseded within a disk array.

## EXHIBIT II



# Disclosure No. 200311026 trivention Disclosure - DBI Document No. 8QSP

PD No. 200311026 Date Received 2/17/03

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General information

Title AHRS - Array-based Hierarchal Rotational Storage

Abstract Traditional disk strays have only 2 levels of hierarchical storage: (1) volable solid state cochemicated memory, and (2) non-retails high-performance, high-priced (3-6 centerIMB) SCBUFC disks (rotellonal storage).

> This patent describes a clar array rotational storage hierarchy. That is, a hierarchically inferior level of low-price (~ 1.5 - 1/5 the price of FC disks), lower-performance Serial ATA (SATA) drives which can be used for temporary/unexpected (but critical) storage and/or for HSM-type low-usage user data slorage.

SATA drives external to the array are not new (nor are SATA-only arrays), what is new is the hierarchical mixing of FC/SCSI and SATA drives within the same array, with the firmwaire empowered to other some SATA storage for low access customer data (as in FW-based HSM) and to retain some for childel short term and unpredictable storage needs that are not appropriate for cache-sharedmemory or high price/performence slorage (or for which there is no pre-ellocated space). This concept is ideal to be used with several prior palent submissions:

- SBLMR Saler Bilmap LUN Mirror Resync[ docket #10011270]
- PLMVS Primary Local Mirror Volume Shadow (docket \$100201390)
- SLM Snapahot Liability Miligation (not yet submitted) BWOP Backup Window Overdraft Protection (not yet submitted)

In which extra storage space (without the constraints of LUN copy Sceness, pre-satigament or pre-configuration) is unexpectedly and temporarily/critically needed within a disk erray (as opposed to having to consider the unconventional use of hot spare disks). Specifically, the patent emitted Backup Window Overdrait Protection' (BWOP) in which a customer (that does not have licensed LUN copy of anapphot functionality, or does not currently have it set up for Zero Downlime Backup) is about to exceed their becamp window, thus being the entire backup.

AHRS empowers EWOP to salvage the endangered backup using temporary nonvolatile storage of sufficient capacity. The AHRS concept would be a significant competitive differentiator and potential look-out spec.

Projects EVA V5.0 Products EVA future

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Allachments R AHRS931105.doc - 3/11/03 12:06PM - ERS (Uplcaded by Bob Cochran)

S Description of invention

Problems Solved See the streethed ERS. Solves the problem of a disk array not having any non-

file:

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Disclose 4.5 - HP Invention Disclosure System

Page 2 of 4

voilille, uncommitted, untital stared storage for which the entry filmware to solve temporary but critical leaves.

#### Prior Bolulions

Sea the attached ERS. Prior sarelys have only (relatively) expensive FC disk drives for non-volities storage.

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   FC Disk arrays
   BATA Disk Drives
   Host SW controlled HSM (uta external components)
   Host SW controlled HSM (uta external components) intra-euray still replication (e.g. eneganous and fut copies)
- Inter-army LUN application
  Auth/RAID, disk stray Flytwhich moves data between RAID-1 and RAID-5 disk

greups, depending on usage patterns (etill all high-coat FC distin).

Auto-LUN, host SW lishish ricyes (like between RAID-1 and RAID-5 disk groups (and 10k spm sind 15k rpm), depending on usage patterns (skill 42 high-coat FC disks).

Description See the attached ERS. Firmness-based Hierarchical Storage Management (HSM) within a disk erroy utilizing both PC and SATA disk drives would be new, in this context, erray FW could save the SATA statings as uncommitted unaturated and only use it lock.

- Lew Usage files (tolerant of lower performance)
  Temporary (but criticat), uncommitted, non-weights alorage that may or may not be pre-ellocated into specific LUNE:
  BELMR Saler Bitmap LUNE Mirror Resynct 1001 1270
  FLIM'S Primary Local Mirror Volume Shadow (10020 360)
  SLM Bragonot Liebtisy Mitigation (not yet submitted)
  WACP Backing Window Overdraft Protection (not yet submitted)

- etc. Intra-array LUN shapshota Intra-array LUN copies Inter-array LUN copies

NOTE: if this concept were an enterior to; just a single related patent, I would have been tempted to combine the two. However, the text that it equally enables at least 4 other patents, suggests that it should not become entangled/identified with any one of them.

Advantages See the attached ERS.
This concept is ideal to be used with several prior patent submissibits.

- SBLMR Sefer Strings LUN Milror Resyncifocket 9 F0011270]
  PLMYS Primary Local Mirror Volume Shadow (docket 9100201390]
  SLM Snapabot Liebility Antigation (not yet automitted)
  BVKOP Backup Windom Overdraft Protection (not yet automitted)

in which exist elerage space (without the constraints of LUN copy Sociatios, pre-essignment or pre-configuration) is usexpecifiedly and temporarily/oritiosity related within a disk erray.



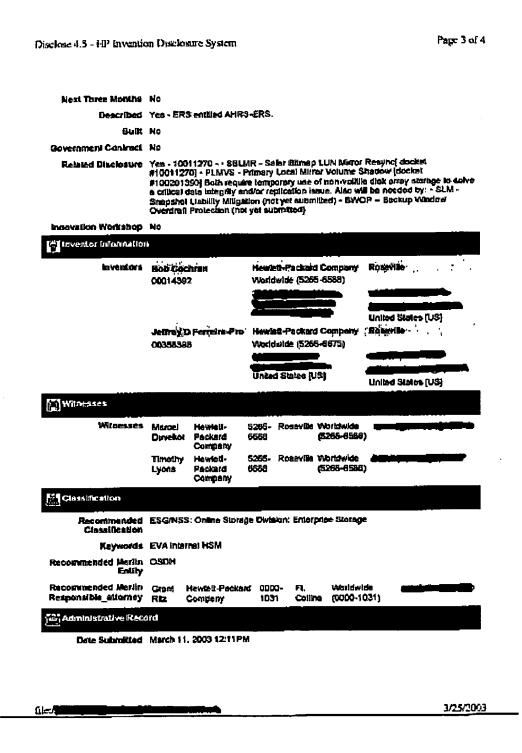
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Published No

Announced No

Disclosed No

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Page 4 of 4 Disclose 4.5 - HP Invention Disclosure System Legal Clerk To 0000 Ft. Worldwide Hewlett-1031 Collins (0000-1031) Pedicard Company PD Number 200311028 Date Received by Metch 17, 2003 Legal 3/25/2003 liles/Al:/sentmel/in2/disalosure\_view.html

# AHRS - ERS

### Rev. 1

# External Reference Specification for: AHRS – Array-based Hierarchal Rotational Storage

(To Accompany the Palant Disclosure by the same name. Intended to supply sufficient date that someone akilled in the art could use this ERS to implement a working model.)

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Bob Cochran - HP RODONIO, CA NES RAD Engineerischerent (Opus 43)

Jeff Ferreira-Pro - HP Rodonio

#### HP Confidential

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Revision H	istory		
Rev.1	1-08-03, 1-11-03		

Page 3

3/25/2003

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Page 4

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3/25/2003

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HP-NSS R&D (Network Storage Solutions)

-Page 16 of 18 -

Page 5

3/25/2003

What "is" new - The Proposed Improvements

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  Temporary (but critical), uncommitted, non-votable storage that may of may not be preallowed into expectic LUNE:

  - SBLMR Saler Blimap LUN Marror Resync(10011270)
    PLANS Primary Local Marror Valume Shadow (100201330)
    SLM Snapehol Liability Mitgation (not yet automized)
    BWOP Backup Window Overdasii Prisiation (not yet submitted)
- intra-unay LUN enepaixos intra-array full LUN copies
- Inter-array LUN copies.

This concept is ideal to be used with several prior patent submissions:

- SBLMR Safer Bitmap LUN Mirror Recynolocket #10011270] PLMV8 Phimitry Local Mirror Valueso Shadov (docket #100201380)
- SLM Suspency Liability Mitigation (not yet submitted)
   BWOP Backup Window Overdraft Protection (not yet submitted)
- etc.

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HP-NSS R&D (Network Storage Solutions)

-Page 17 of 18 -

# APPENDIX III

Page 1 of 1

### Ken Koestner

From: "\$CHULZE,TARA (HP-FtCollins,ex1)" <tara.schulze@hp.com>

\*kkoesiner@kbpatents.com>

Sent: Monday, June 30, 2003 1:34 PM

Attach: 200311028.pdf; Supplemental Procedures for new cases.pdf; RFQ 200311026.doc

Subject: RFQ for New HP case=200311026

Crant Ritz requested that I forward the above referenced disclosure to you for drafting.

Please find attached:

- RFQ and letter of engagement
- Disclosure 200311026
- Supplemental procedures for new cases

Please confirm receipt of this transmission via e-mail reply.

Thank you.

9/15/2006

-Page 18 of 18 -